International Journal of Medicine and Pharmaceutical Science (IJMPS)
ISSN(P): 2250-0049; ISSN (E): 2321-0095
Vol. 7, Issue 3, Jun 2017, 31-36

VALUE ADDITION FINISHING OF PROTEIN FIBRES USED FOR TECHNICAL TEXTILE

RAVIKANT SHARMA[1], BABITA CHAUDHARY[2] & USHA SAYED[3]

[1,2]*Department of Fibres and Textile Processing Technology, Institute of Chemical Technology, Mumbai, India*

[3]*Professor Department of Fibres and Textile Processing Technology, Institute of chemical Technology, Mumbai, India*

ABSTRACT

In the textile industry, there are some aspects for their growth and development i.e., 1. Value-added products with enhanced functionality, 2. Apparels, 3. Sustainable products. Antimicrobial textiles which improve functionality find a variety of applications in health and hygiene products, especially the garment worn close to the skin and several other medical applications for infection control and as barrier material. In the last few decades with the increase in new antimicrobial finishing technologies, there is an ever growing need of natural products for various finishing applications. With the steady improvement in technology and application standards, a gradual rise has been observed in consumer demands and to reach up to that mark, a manufacturer has to add something to their products to get some added value for their products. Protein fibers can be easily modified to form a specialist substrate by chemical modification. In this project we used raw wool and silk to increase their shelf-life by finishing with a novel anti-microbial finishing agent. Citizen along with Oxy-tetracycline was synthesized and successfully applied on dyed and undyed wool and silk, to obtain an excellent antimicrobial activity along with a bright colour. It also imparted better physical property like tensile strength. Such modification can be used in Agra textile, medical textiles and also in home tech.

KEYWORDS: Value Addition, Antimicrobial, Chitosan & Technical Textiles

Received: Apr 07, 2017; **Accepted:** May 09, 2017; **Published:** May 25, 2017; **Paper Id.:** IJMPSJUN20174

Original Article

INTRODUCTION

Textile products like, wool and silk are made up of amino acids, so, easily attacked by micro-organisms, and due to this, they loss their strength and value. Hence, to protect this type of fabrics from pathogens is a growing concern challenge in the industry. Microorganisms such as bacteria, fungi or insects are responsible for a lot of type's infections and allergic reaction to the human skin. For the production of anti-microbial textiles, there are three main problems remain i.e.

- Demonstration of successfulness or effectiveness,
- To claim successfulness that it does not invite a legal challenge,
- Keep going efficacy over the fabrics [1].

Oxytetracycline is yellow in colour, odorless crystalline powder with broad spectrum tetracycline group of antibiotic in nature. It has an ability to stop production of essential protein onto the substrates, due to the lack of these proteins bacteria cannot grow, multiply on to the sample. Oxytetracycline helps to prevent the spread of infection, and the left over bacteria are killed by the immune system [2]. The salt form of Oxytetracycline is also known as Oxy-tetracycline hydrochloride, which also exhibits an antimicrobial activity on the fabrics [3]. Oxy-tetracycline is

primarily bacteriostatic, and is thought to exert its antimicrobial effect by the inhibition of protein synthesis. It shows an effect against the gram-negative and gram-positive organisms [4]. Air does not affect the activity of the tetracycline or Oxy-tetracycline, but expose to sunlight affect the activity of the drugs so it should be kept away from the direct sunlight. It has higher antimicrobial activity at acidic pH, i.e. 2-4 pH and activity is destroyed by alkaline pH. It is very slightly soluble in water, but freely soluble in diluted acidic medium [5].

Silk is an animal fiber and it is also called as protein fiber. Silk is an only fiber which is found in filament form. Silk is produced by insects. Fibrin is the main chemical component of silk [6]. Protein fibers like silk and wool are amphoteric in nature due to the presence of carboxylic group and free amino group it can be dyed with either by anionic dye or cationic dyes. Due to presence of slightly cationic nature, it can be dyed with anionic dyes like acid dye, metal complexes dyes and reactive dyes [7].

Properties

- Light weight fiber due to low density.
- High resistance to distortion.
- Best insulation properties.
- Compare to all other fibers, silk is a strong fiber.
- It has good affinity to various dyes.
- Having a good lustrous property with shine.

METHODS AND MATERIAL

- Ready for dyeing Silk purchased from Piyush Syndicate Ltd, Thane
- Acetic Acid
- Oxytetracycline by Piramal Healthcare Limited, Gujrat,

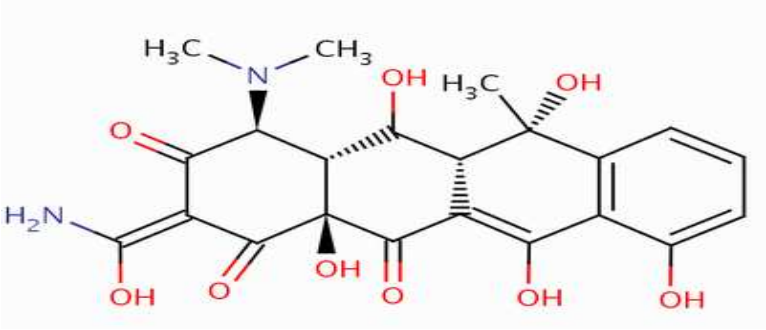


Figure 1: Oxytetracycline

Dyeing Procedure

Oxytetracycline was dissolved in 1% acetic acid solution and made a 10 gpl, 20 gpl, 30 gpl solutions then silk fabric were dyed by the pad dry method. 2 dip 2 nip was given by a percentage expression of 70%.

Determination of Add-on %

The fabric samples were conditioned at 65% RH and 27ºC for 48 h. After conditioning the samples were finished with the above compound and % add-on was determined by gravimetric method as follows.

Add-on%= [M2-M1/ M1] * 100

Where, M1 and M2 are the oven dried weight of the control and the treated samples, respectively. The reported results are average of 5 readings [8].

Analysis of Samples

The fabric samples were treated with all the above mentioned processes in the presences of additives tested for evaluation for their performance properties.

Colour Depth (in terms of K/S values):

Dyed samples were evaluated for the depth of the colour by determining K/S values using a Spectra flash, Computer Colour matching system supplied by Data colour international, U.S.A. An average of four readings were taken at four different sample areas, to calculate the reflectance value, the KulbekaMunk K/S function which is given by:

K/S = ((1-R)2) /2R

Where,

"R" is the reflectance at complete opacity.

"K" is absorption coefficient.

"S" is the scattering coefficient.

Washing Fastness (W.F)

The washing fastness of the samples was tested using the ISO III test. The test was carried out by adding 2gpl anhydrous sodium carbonate to 5 gpl non-ionic soap. The composite sample was treated at 60 deg C for 30 mins at MLR 1:50, followed by rinsing twice in distilled water, followed by 10 minutes washing in cold running tap water. After squeezing, the stitching on all but one of the shorter sides was removed and drying was carried below 60 deg C by hanging. Staining scale assessed the staining of adjacent fabric.

RESULTS AND DISCUSSIONS

AATCC 100 Test Method

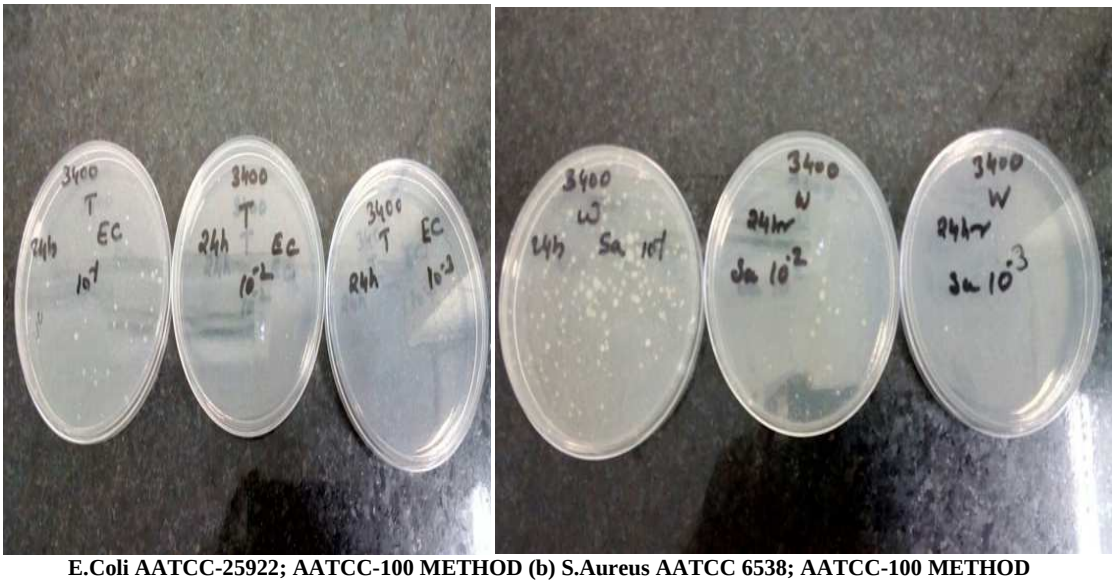
This is a quantitative test method for determination of antimicrobial activity of the fabrics over the contact time of 24 hours against E. Coli gram negative bacteria and S. aureus gram positive bacteria. The broth medium with specific and known qualities of microbial culture media is prepared in incubation for 24 hours to obtain a higher concentration of test organisms. With the help of standard micro-organism monitoring technique, the bacteria are counted on the fabrics at the initial stage i.e. '0' hour. After that, the inoculated samples are incubated for 24 hours under favourable conditions of nutrients and temperature. If the bacteria increase in the numbers, then the fabric does not have the antimicrobial property. In the untreated control sample, the microbial growth will increase and by using initial count and surviving count data, the percent reductions in micro-organisms are calculated.

Test Organism According To AATCC 100 Antimicrobial Test Standards

- Staphylococcus aureus and E. Coli

Sample Size Required for AATCC 100 Test Method

- 4.8 * 4.8 CM Squares [9]



E.Coli AATCC-25922; AATCC-100 METHOD (b) S.Aureus AATCC 6538; AATCC-100 METHOD

Figure 2: Silk Sample "24" Hours Colonies on Nutrient Agar Plate from Unwashed and Washed for Sample

Table 1: Anti-Microbial Activity of Silk Fabrics

Evaluation of Antimicrobial Activity	Substrate	% Reduction
E.Coli AATCC-25922 AATCC-100 METHOD	Treated Silk Sample	98.2 %
	After Washed Silk Sample	82.4%
S.Aureus AATCC 6538 AATCC-100 METHOD	Treated Silk Sample	93%
	After Washed Silk Sample	71.8%

Protein fibers, like silk and wool are made up of amino acids, which can be dyed either by acid dye or Basic dye. Silk is a protein fiber, so it can be easily attacked by micro-organisms, and, being delicate and costly fiber, such degradable attacks will further increase the cost of the silk fabric. Hence, in this project, silk fabric was dyed and finished at the same time by using Oxytetracycline, which impart yellow colour to the silk fabric and at the same time, it provide the anti-microbial finishing against the gram-positive bacteria (*S. Aureus*) and gram-negative bacteria *(E. coli*). Silk fabric treated with Oxytetracycline drug inhibit the growth of bacteria shown in **figure 2.** The **%** reduction of E. coli bacteria in treating sample was 98.2%, after wash the silk fabric % reduction of bacteria was 82.4%. Similarly, **%**reduction of S. aureus bacteria in treating the silk sample was 93 %, after wash the fabric % reduction of bacteria was 71.8%.

The above observation lead to the fact that although the drug may not be suitable for human consumption due to its expiry, it still has an anti-microbial functional groups present in the molecules. This, after hinging onto the fabric by the ionic bond, functions to impart anti-microbial property to the fabric. The pH of the compound being acidic in nature inhibits the growth of some micro-organisms and bacteria in the fabric.

Table 2: Color Strength Values of Dyed (OTCH) Silk Fabrics

Sr. No.	Sample	L*	a*	b*	C*	H*	% Colour Strength	K/S
1.	Untreated Silk fabric	82.01	0.461	10.86	10.88	87.54	134.50	0.5353
2	Dyed Silk (10gpl)	72.99	-1.47	15.71	15.11	92.37	420.16	1.722
3.	Dyed Silk (20gpl)	68.20	-1.38	18.52	18.32	94.58	498	1.98
4.	Dyed Silk (30gpl)	65.85	-1.29	19.89	19.95	96.24	520	2.28

Table 3: Fastness Properties of Dyed (OTCH) Silk Fabric

Sr. No.	Silk Dyed with OTCH	Washing Fastness	Light Fastness	Rubbing Fastness		Fastness to Perspiration	
				Dry	Wet	Alkaline	Acidic
1.	Std Silk	-	-	-	-	-	-
2.	Dyed Silk (10gpl)	4	4-5	5	5	4	4-5
3.	Dyed Silk (20gpl)	4-5	4-5	5	4-5	4-5	4
4.	Dyed Silk (30gpl)	4-5	4	4-5	4	4-5	4

Silk fabric was treated with Oxytetracycline drug, which imparted both dyeing and anti-microbial finishing of the fabric as seen in **Table 1 and Table 2.** As the concentration of the oxytetracycline drug increases, then the depth of the colour also increases and the lightness of fabric decreases with increases in the K/S value, as seen in **Table 2.** Washing fastness property of the dyed silk fabric also increases with increases in the concentration of oxytetracycline drug, with decreases in the light fastness property of the fabric. The rubbing fastness properties of the fabric also decreases with increases in the concentration due to darker shade, as seen in **Table 3.**

CONCLUSIONS

- The project under taken above has a number of significant conclusion namely:-
- Oxytetracycline can be used for value added finishing of silk fabric
- Expired above drugs can also be used for value added finishing of silk fabric
- Successful recycling of waste pharmaceutical drugs instead of land filling.
- It also suggest the organised collection of waste drugs either from hospitals, household, medical stores or companies manufacturing the drugs for a profitable enterprise in textile processing.
- It also gives new wide gamut of colour.
- Thus, the proposed method of dyeing and antimicrobial finishing of protein fibres with oxytetracycline drug can be a value addition and opens up a new area of research, and is a promising niche area such as medical and health care textiles, to the aspiring candidates.

ACKNOWLEDGEMENT

The Authors are thankful to the Department of Fiber and Textile Processing Technology, Institute of Chemical Technology, Matunga, Mumbai for providing infrastructural facilities and Department of Science and Technology (DST) India for providing financial support for this research work.

REFERENCES

1. *http://www.fibre2fashion.com/industry-article/3265/antimicrobial-products-in-textile-industry?page=3*
2. *https://en.wikipedia.org/wiki/Oxytetracycline*
3. *https://pubchem.ncbi.nlm.nih.gov/compound/oxytetracycline_hydrochloride#section=Patents*
4. *https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=6b4de8c9-8a32-4a07-9183-419d6177ea08*
5. *Andrés R. Sánchez, Roy S. Rogers III, and Phillip J. Sheridan, Tetracycline and other tetracycline-derivative staining of the teeth and oral cavity. Int J Dermatol. 2004 Oct; 43(10):709-15.*
6. *http://textilefashionstudy.com/silk-fiber-physical-and-chemical-properties-of-silk/*
7. *Md. Koushic Uddin, Ms. Sonia Hossain (2010), A Comparative Study on Silk Dyeing with Acid Dye and Reactive Dye, IJET-IJENS Vol:10 No:06*
8. *Ashis Kumar Samanta and AdwaitaKonar, Dyeing of Textiles with Natural Dyes, page no.43-46*
9. *http://www.accugenlabs.com/aatcc%20100.html*